II. ENVIRONMENTAL SETTING

A. PHYSIOGRAPHY AND TOPOGRAPHY

The project area is within the Atlantic Coastal Plain physiographic province, which is generally characterized by low-lying, nearly level topography. The Coastal Plain was formed by the deposition of material transported from beyond the fall line, and is characterized by masses of unconsolidated sediments comprised of sands, gravels, and clays of marine or fluvial origin. Surface elevations within the SR 1 corridor vary from sea level to 70 feet above sea level. The corridor crosses two tidal creeks, the Appoquinimink River, and Drawyer Creek (Plate 1). The freshwater/saltwater boundaries in these creeks are currently just west of the project area. The banks of these creeks are quite steep, but the terrain in the corridor is otherwise gently sloping or nearly flat. According to the regional divisions established by the Delaware State Historic Preservation Office (Ames et al. 1989), the project area is in Region II, the Upper Peninsula. Custer (1986) places this area in the Mid-Drainage unit of the High Coastal Plain.

Although the state plans place the project area in a single geographic region, it actually contains two quite different topographies. North of Fieldsboro, the soil is well drained, and there are few wetlands other than those along the creeks and streams; the only large wetlands are the tidal marshes along Drawyer Creek and the Appoquinimink River. South of Fieldsboro, the poorly drained soils support numerous bay/basin ponds and other small wetlands, and sizable marshes are found along insignificant creeks. Wetlands are thus widely distributed across the landscape and comprise a significant percentage of the total land area. Since many wetlands have been drained for agricultural purposes in the past century, the area was probably even swampier in prehistoric times.

B. SOILS

The dominant soil association in the project area is the Matapeake-Sassafras. Matapeake-Sassafras soils are found in upland areas on level to steep topography, and are well drained and coarse to moderately coarse. The Matapeake-Sassafras soils are highly productive, and support some of Delaware's most intensive and profitable agriculture. South of Fieldsboro, and in the Osborne and Lynch wetlands, the Matapeake-Sassafras soils give way to Sassafras-Falsington soils, which are similar to Matapeake-Sassafras soils but include more areas of poorly drained soil less suitable for agriculture. These soils contain many bay/basin ponds and other small wetlands. Even in the most poorly drained areas, however, ridges of well-drained, sandy soil are present. Sand ridges, apparently ancient dunes, dominate the topography of the Osborne wetland, the southernmost part of the project area. Soils of the Tidal Marsh association are found along Drawyer Creek and the Appoquinimink River (Mathews and Lavoie 1970).

PLATE 1: Aerial View of the U.S. Route 13 Bridge over Drawyer Creek

C. PALEOENVIRONMENT

Given the widespread evidence of human occupation of the Middle Atlantic Coastal Plain beginning as early as the Late Pleistocene, a reconstruction of the area's environmental history should consider at least the last 12,000 to 15,000 years. The primary factors to be considered in a local paleoenvironmental reconstruction are changing climatic conditions and sea levels, which, in turn, influenced the local distribution of floral and faunal resources.

During the late Pleistocene, a series of massive continental glaciers advanced and retreated over much of North America. Because vast amounts of water were incorporated into these ice sheets, the sea levels were 300 to 500 feet lower than at present. The late Pleistocene was not only slightly cooler than the present, but was also characterized by higher levels of precipitation (Carbone 1976).

The generally accepted marker for the end of the Pleistocene is the beginning of the glacial retreat immediately following the Valders substage maximum, which has been dated radiometrically to about 10,500 years Before Present (BP) (Bryson et al. 1970). As the sea levels rose with the release of the glacial meltwater, the ancestral Susquehanna River Valley and the Delaware River Valley were drowned, and the rising water eventually formed the estuarine environments of the Chesapeake Bay and the Delaware River.

While data indicate that sea level has been rising continuously during the past 12,000 to 14,000 years, the rate of marine transgression over the Coastal Plain has varied considerably. In the millennia immediately following the glacial maxima, sea levels rose relatively rapidly, while in the most recent millennia, sea levels have been rising at a rate of somewhat less than one foot per century (Edwards and Merrill 1977).

The biogeographical patterns of the Middle Atlantic Coastal Plain for the late Pleistocene have not yet been definitively reconstructed. Detailed paleoenvironmental syntheses have been completed for the Shenandoah River Valley (Carbone 1976) and the Upper Delaware River Valley (Dent 1979). These studies are useful for understanding regional paleoenvironmental conditions; however, a reconstruction of local conditions should also consider applicable pollen cores. For Delaware, Custer (1984, 1986) relies heavily on Carbone's (1976) work, and discusses paleoclimatic history in terms of an episodic model wherein abrupt, rather than gradual, changes in climate influenced the regional biogeography. A summary of the regional paleoenvironmental history, based on Custer's (1984, 1986) statewide synthesis, is presented in Table 1.

Paleoenvironmental data for the SR 1 corridor have been synthesized in a recent study prepared by the University of Delaware Center for Archaeological Research (UDCAR) (Kellogg and Custer 1994). Recent geological and palynological studies of four bay/basin features in central Delaware provide a detailed look at paleoenvironmental conditions in the vicinity of the project area (Webb et al. 1989). These studies showed that water levels were high in Delaware in the late Pleistocene, leading to the deposition of sediments in these basins at rates of up to 20 cm/year. Sometime between 9000 and 4000 BC, water levels fell and these ponds dried up, leading to a discontinuity in the depositional sequence. After 4000 BC, water levels rose and deposition

TABLE 1 PALEOENVIRONMENTAL EPISODES, DELAWARE COASTAL PLAIN

EPISODE	DATES	GENERAL CHARACTERISTICS
Late Glacial	10,000-8000 BC	Mosaic of different vegetational communities; open grasslands within coniferous forests; deciduous elements present in wetland areas; bay/basin features open and active; animals include cold-adapted megafauna (musk ox, mammoth, and mastodon), peccaries, white-tailed deer, caribou, and elk
Pre Boreal/Boreal	8000-6500 BC	Reduction of open grassland and spread of forest dominated by pine and northern hardwoods; extinction of Pleistocene megafauna and reduction of habitat for grazing species
Atlantic	6500-3100 BC	Full appearance of modern environment with warm, moist conditions; continental climate with marked seasonal differences; widespread dominance of mesic oak-hemlock forests; modern faunal communities
Sub-Boreal	3100-800 BC	Warm, dry climate (mid-postglacial xerothermic) at the beginning of the episode, followed by gradually increasing moisture and cooling temperatures; spread of grasslands and reduction of oak-dominated forests
Sub-Atlantic	800 BC-present	Cooling reduced the moisture stress of the Sub-Boreal, leading to essentially modern conditions; upland forests include a mix of coniferous and deciduous species; reduction of sea level rise permits florescence of estuarine environments in coastal areas

resumed. Pollen recovered from these sediments was dominated by spruce, pine, and birch, showing that the environment around 9000 BC was sub-Arctic. After deposition resumed in 4000 BC, the pollen was dominated by oak and buttonbush (a wetland shrub), both dominant species in historic ecosystems. These data do not exactly correspond to Carbone's generalized model for the Middle Atlantic region (see Table 1). Carbone posits a dry period beginning about 8500 BC, which closely matches the new Delaware data, but he estimated that it ended by 6500 BC, in contrast to the 4000 BC date from Delaware. However, both models posit a long dry period in the early Holocene, followed by wetter conditions, and this general agreement may be more important than the differences in dating.

Important environmental information on the project area was obtained by Kraft (1977) in a study of sea level rise in the Appoquinimink River drainage. According to his study, tidal waters had reached the confluence of the Appoquinimink River and Drawyer Creek by 8000 BC and the project corridor by 4500 BC. By 1000 BC, tidal waters had reached Silver Lake, the current boundary of tidal action in the Appoquinimink River. Well-developed tidal marshes were present around the project corridor by that time. Although there has been some expansion of the tidal region and further development of marshes since that time, the gross situation has remained largely unchanged. The project area has, therefore, represented an attractive environment for hunter-gatherers, providing abundant, diverse food sources for at least the past 6,500 years.

D. MODERN ENVIRONMENT

Essentially modern environmental conditions were reached approximately 1,000 years ago, during the Sub-Atlantic episode. Some minor climactic fluctuations have taken place since that time, but it is generally agreed that modern distributions of flora and fauna closely approximate those of the past 1,000 years. The only major changes have been the result of agriculture, land clearance, and other human activity, and the introduction of some Old World species.

At the time of European contact, most of Delaware was covered with deciduous forest. This was a productive environment providing a variety of plant and animal resources for the human inhabitants. Oak was the dominant forest species, with some loblolly and virginia pine, hickory, and chestnut. Poorly drained areas supported a mixed forest of pin oak, willow oak, red maple, sweetgum, blackgum, and many smaller trees. A diverse mammalian community occupied these forests, with wolf, puma, and black bear as the dominant predators, and white-tailed deer the most common large herbivore. Other species that provided important food sources for humans include turkey, groundhog, squirrel, raccoon, opossum, rabbit, and porcupine. Tidal marshes, found along the Appoquinimink River and its tributaries, were a particularly important resource, providing plants such as wild rice, cattails, arrowroot, and irises, as well as fish, shellfish, turtles, ducks, geese, herons, and muskrats. In the southern part of the project area, where soils are not as well drained, there were numerous small freshwater wetlands associated with streams and bay/basin ponds. These wetlands supported water-loving plants such as willows, arrowwood, buttonbush, sedges, wetland grasses, and sphagnum moss, and animals such as beavers, muskrats, raccoons, herons, ducks, frogs, and turtles.

Since the late seventeenth century, the Odessa-Middletown area has been prime agricultural land. North and west of Odessa, wheat quickly became the principal crop, while south of Odessa, corn predominated. Much of the project area retains its agricultural character, although increasing portions are taken up by residential and commercial development, particularly in the northern end of the project area along U.S. Route 13.